UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING
Washington, D. C.

FIELD LETTER FOR OCTOBER
November 1, 1916.

No. 21.

CONSTRUCTION.
Vernon M. Peirce, Chief.

General.

V. M. Peirce, Chief, inspected the experimental sand-clay road in Prince Williams County, Virginia, October 27.

J. T. Voshell, S. H. E., attended the Annual Meeting of the National Paving Brick Manufacturers Association at Terre Haute, Indiana, October 5 and 6, to witness the demonstration of constructing monolithic brick roads. He also inspected the work being done at Palm Beach County, Florida, under the supervision of this Office, and the work on the Post Road in McDowell County, North Carolina.

J. W. Janssen, H. E., has tendered his resignation to take effect November 1.

Advice and Inspection.

M. E. Worrell, H. E., cooperating with the State Highway Department of Tennessee, is planning a system of roads for Hickman County to be constructed from a proposed bond issue.

J. C. Wonders, S. H. E., cooperating with the State Highway Department of West Virginia, is supervising the construction of a district system of roads at Terra Alta, West Virginia.

H. C. Wells, S. R. C., is cooperating with the State Highway Department of West Virginia in preparing a map for a State road system.

R. E. Toms, S. H. E., accompanied a committee from Nashville to New Orleans and return, October 2 to 20, to determine the most practicable route for the Jackson Highway between these points.

W. H. Rhodes is assisting the State Highway Department of Tennessee in supervising the surface treatment of a number of roads which are being maintained by the State Automobile Fund.

W. H. Lynch, S. H. E., completed a report for a county system of roads for Yuba County, California, October 10, and was assigned to assist Mr. Sweetser in supervising the construction of Federal Aid roads in California.

F. A. Davis, J. H. E., cooperating with the State Highway Department of Oklahoma, is planning a system of roads for Earle Township in Jefferson County, and for Custer County. Waurika is his headquarters.

B. H. Burrell, S. H. E., and H. K. Craig, H. E., have completed their assignments at Billings, Missouri, and Chester, South Carolina, respectively, and have been assigned to assist the State Highway Department of Louisiana in making surveys of and plans for improving some roads which the State proposes to construct.

Experimental Roads.

J. T. Pauls, J. H. E., completed his assignment on the Ohio Post Road October 2, and has been assigned to assist Mr. Moorefield in supervising the construction of a bituminous concrete experimental road in Fairfax County, Virginia.

H. H. Lotter, S. H. E., completed the construction of an object-lesson concrete road at Coldwater, Michigan, October 25, and has been assigned to take charge of constructing an experimental sand-clay road in Prince Williams County, Virginia.

MAINTENANCE.
E. W. James, Chief.

Inspection, Advice and Lectures.

W. L. Spoon, S. H. E., addressed a meeting at Yanceyville, N. C. October 2 and on the 22d made an inspection of the road from Durham to Southern Pines through Lee and Chatham Counties.

D. H. Winslow, S. R. C., addressed a meeting at Kinston, N. C. October 2 and on the 10th appeared before the Farmers Union and Business Men's association at Kenbridge, Virginia. Mr. Winslow also attended the North Carolina State Fair at Raleigh on the 18th, 19th and 20th, giving twelve illustrated lectures to a total attendance of about 1200.

Geo. C. Scales, S. H. E., appeared with Representative Byrnes before the County Commissioners of Aiken County, S. C. October 10, to arrange for experimental maintenance of the South Carolina Post Road in Aiken County, and on the 20th attended a meeting in McCormick County, S. C. and advised with officials and prominent citizens regarding the improvement of the county road system.

V. E. Towles, H. E., attended the opening of the South Carolina State Fair October 23, and on the 26th was at the County Fair at Fayetteville.

Mr. James had an article in the Engineering Record of October 7 on "The Analysis of Traffic Distribution on a Rectangular System of Roads", and an article in the October issue of Southern Good Roads entitled "The Real Cost of a Road".

WASHINGTON-ATLANTA HIGHWAY.

The good weather of the past month has enabled the engineers in charge of the Washington-Atlanta Highway to repair the damage done by the storms in July and August, so that with the exception of bridges that were washed out, the entire road has been put into satisfactory condition.

CENTRAL HIGHWAY.

D. H. Winslow is now covering his section by train and livery on account of a serious strain, which temporarily prevents him from operating a car.

Construction work in Alamance County has advanced satisfactorily.

Work of widening a section in Guilford County was continued during the month. In Orange County, the Highway has been marked with color signs and the work will be continued eastward to Durham. The color scheme is a blue-white-blue band.

FIELD EXPERIMENTS.

The work of retreating section 1 of the Rockville Pike between Bradley Lane and Bethesda, was completed October 19. Cost data will appear later.

The Falls Road, Section 1, was retreated October 2 to 6. Section 3 will be retreated early in November. Sections 1, 2, 3 and 4 of the Agricultural Department grounds, Washington, were retreated September 25 and 26 and October 9 and 10.

Sections 3 and 4 of Kensington Road, North (concrete) have been given a carpet coat as follows: sub-sections A, B, G & H, Ugite 3 with torpedo sand; sub-sections C, D, E and F, asphaltic petroleum, Specification O-49, with torpedo sand. Sub-sections I & J, asphaltic petroleum (Mexican), double application with torpedo sand. Cost data will be given later.

Retreatment costs of the work on the Agricultural Grounds and Section 1 of the Falls Road, follow:

RETREATMENT COSTS OF SECTION 1,
AGRICULTURAL GROUNDS,
WASHINGTON, D. C.

September 26, 1916.

HAULING:

2 teams and drivers, 8 hours each	$9.00
1 team and driver, 4 hours	2.25
1 horse and cart, 8 hours	3.00
	$14.25

SWEEPING SURFACE:

1 laborer, 1 hour	$0.25
1 " 1 "	.21
1 " 1 "	.19
	$0.65

POURING OIL:

1 laborer (Patrolman) 8 hours	$2.33

BROOMING OIL:

1 laborer, 5 hours	$1.25
1 " 5 "	1.05
1 " 5 "	.95
	$3.25

SANDING SURFACE:

1 laborer, 8 hours	$2.17
1 " 8 "	2.00
	$4.17

SWEEPING SAND:

1 laborer, 4 hours	$1.25

SUPERVISION:

1 Engineer, 8 hours	$5.33

COSTS FOR RETREATING
SECTION 2, AGRICULTURAL GROUNDS,
WASHINGTON, D. C.
September 25, 1916.

Area treated ..... 1093 sq.yds.
Top dressed with Torpedo sand.

MATERIALS.

Bitumen (Trinidad A) 172 gallons ..... 0.1573 gal. per sq.yd.
Torpedo Sand, 6 cu.yds. ..... 0.0055 cu.yds. per sq.yd.or 182.16 + sq.yds. per cu.yd.

COSTS.

LABOR - Hauling.....	$3.00	.....	$0.00274	per sq. yd.
Sweeping surface	0.65	.....	0.00059	" "
Pouring oil.....	2.33	.....	0.00213	" "
Brooming oil....	3.90	.....	0.00357	" "
Sanding surface.	4.17	.....	0.00382	" "
Sweeping sand...	1.25	.....	0.00114	" "
Supervision.....	5.33	.....	0.00488	" "
	$20.63	.....	$0.01887	

Bitumen (Trinidad A) ...	172 gallons	...	$18.92	...	$0.01731 per sq.yd.
Torpedo sand, ...	6 cu.yds.	...	9.60	...	0.00878 " "
			$28.52	...	$0.02609

Total cost of materials	$28.52	.....	$0.02609
" " " labor	20.63	.....	0.01887
	$49.15	.....	$0.04496

RETREATMENT COSTS OF SECTIONS 3-4
AGRICULTURAL GROUNDS,
WASHINGTON, D. C.

October 9-10, 1916.

HAULING:

2 teams and drivers, 8 hours each	$10.00
1 team and driver, 3-1/6 hours	3.98
1 cart and horse, 6 hours	2.25
1 cart and horse, 5 hours	1.87
	$18.10

SWEEPING SURFACE:

1 laborer, 6 hours	$ 1.50
1 " 2 "	0.50
1 " 1 "	0.27
1 " 1 "	0.22
1 " 1 "	0.21
	$ 2.70

POURING OIL:

1 laborer (patrolman) 6 hours	$ 1.75
1 " " 5 "	1.46
	$3.21

BROOMING OIL:

1 laborer, 10 hours	$ 2.71
1 " 10 "	2.19
1 " 10 "	2.09
1 " 5 "	1.10
	$ 8.09

SPREADING SAND:

1 laborer, 6 hours	$ 1.88
1 " 5 "	.94
1 " 3 "	.75
	$ 3.57

SUPERVISION:

1 engineer, 11 hours	$ 7.34

RETREATMENT COSTS FOR SECTION 1.
F A L L S R O A D.
MONTGOMERY COUNTY, MARYLAND.
OCT. 2 to 6, inclusive.
1916.

Area treated ..... 7625 sq.yds.
Top dressed with Torpedo sand.

MATERIALS.

Bitumen (Aztec), 1760 gallons	0.2308 +	gal. per sq.yd.
Torpedo sand, 87 cubic yards	0.0114 +	cu.yds. per sq.yd.
	or 87.64	sq.yds. per cu.yd.

COSTS.

Bitumen (Aztec), 1760 gallons	$192.19	$0.0252 +	per sq.yd.
Torpedo sand, 87 cubic yards	191.40	0.0251 +	" "
	$383.59	$0.0503 +	

LABOR - Hauling	$58.49	$0.00767 +	per	sq.yd.
Sweeping road..	7.44	0.00097 +	"	"
Pouring oil....	8.00	0.00104 +	"	"
Brooming oil...	19.25	0.00253	"	"
Spreading sand.	13.82	0.00182	"	"
Supervision....	26.67	0.00350	"	"
	$133.67	$0.01753		

Total cost of materials ...	$383.59 ...	$0.0503 +
" " " labor.....	133.67 ...	0.01753
	$517.26 ...	$0.06783

ROAD MATERIAL TESTS AND RESEARCH.
Prevost Hubbard, Chief.

Projects.

Administration.

R. E. Esher was appointed to the position of Student Assistant in the Chemical Laboratory October 4. It is expected that a number of appointments to laboratory positions will be made in November from the new Civil Service list of eligibles for Laboratory Assistants.

Mr. Hubbard attended the Annual Convention of the American Society of Municipal Improvements, October 9-13, inclusive, at Newark, N. J., and reports that as the result of the recommendation of the Committee on Broken Stone and Gravel Roads, of which he is a member, the Society adopted a specification for the construction of gravel roads which embodies the essentials covered in the typical specifications prepared in this Office.

Routine Tests and Analyses.

In October, 87 samples of bituminous material were examined in the Chemical Laboratory, a large proportion of which were daily plant and road samples from the Alexandria-Accotink Experimental Road. Over 100 samples of rock, sand, gravel, etc., were examined in the Physical Laboratory, and 65 samples were examined and classified in the Microscopic Laboratory.

Research Upon the Properties of Dust Preventives and Road Binders.

The experimental topping apparatus at the bituminous refining plant at Arlington Farm was tried out in October and after some slight modifications probably will be in practical working condition. As soon as crude petroleums can be dehydrated successfully in this plant, researches upon the effect of manufacturing processes upon the physical and chemical properties of Mexican petroleum products will be pushed rapidly.

The new viscosity tester designed in the Office promises to be of great value in determining the consistency of the fluid products whose viscosity cannot be determined at 25°C. with the Engler viscosimeter, and which are too soft for the penetration test. The work so far accomplished indicates that the results obtained with this instrument are directly comparable with the actual viscosity determined with a given weight of material in the Engler instrument, an almost straight-line curve being obtained for the relation between the two instruments. It would therefore seem possible, by extending this line, to state in Engler terms at 25°C. the viscosity of products which are too viscous to determine by means of the Engler instrument at that temperature.

Work is being continued on the improvement of the ultramicroscopic cell devised in the Office, and additional apparatus has been ordered for counting the extremely small particles held in solution.

Nonbituminous Road Material Investigations.

A new abrasion machine has been ordered for use particularly in connection with the development of a standard abrasion test for gravel, and this line of investigation will be pushed rapidly as soon as the machine is installed.

The new cube apparatus for washing laboratory samples of sand and gravel was installed, and the few preliminary tests which have been run indicate that the machine will prove entirely satisfactory.

Much additional data has been obtained as to the relation between the mechanical analysis of sands and the tensile strength of mortars. It is probable this data will be worked into shape for publication.

A method devised by Mr. Goldbeck for determining the normal consistency of sand mortars, based upon a determination of the superficial area of the sand grains, is being tried out in the laboratory with every evidence of success.

A brick rattler has been delivered at the Arlington Farm and will be set up in the cellar of the soil-pressure building. Within a few weeks the Office will be prepared to make standard tests on samples of paving brick.

Impact tests of sections of brick pavements with different types of cushions and fillers have been continued and the following general observations have been made from the experiments so far conducted: The actual resistance to impact offered by the brick appears to be the same regardless of the type of cushion and type of grout. The resilience of brick pavements laid with a bituminous grout on a sand cushion, a cement grout on a sand cushion and a cement grout on a mortar cushion appears to be in about the ratio of 2:3:10. The cement grout apparently cracks under less impact where a sand cushion is used than in the case of a mortar cushion. Failure of the brick under impact has been accompanied by a failure of the concrete base in all cases where a mortar cushion was used, but no failure of the base has been noted where a sand cushion was used. In every case where the mortar cushion was used the impact causing failure has been sufficient to cause the section of brick to separate from the base.

The effect of controllable variables upon the toughness test for rock is being studied and for this purpose three drill crowns have been prepared to produce rock cores of slightly different diameter. A large number of cores have been drilled from several types of homogeneous rock and will be tested as soon as possible.

Experimental Bituminous Road Construction and Maintenance.

The experimental bituminous gravel concrete road between Alexandria and Gum Spring has been continued with the same plant inspection provided in former months. About 600 feet of this road has been allotted for an experimental section of a soil-asphalt mix similar to that laid during the month of May at Arlington Farm. The soil for this section has been selected from a location near the present mixing plant of the contractor, and it is anticipated that the section will be laid in the course of two or three weeks. To date the section at Arlington Farm has shown up in a particularly satisfactory manner.

It is proposed to measure the amount of wear and wave formation in the bituminous gravel concrete road, and concrete monuments prepared for this purpose will be placed in suitable positions along the road.

The bulletin on the expansion and contraction of concrete is almost completed and will be edited in a short time.

Concrete Investigations.

The construction of another large slab for test purposes has been delayed considerably owing to the time and labor required to remove the last slab which was 16 inches thick. This slab has been removed in sections from the laboratory and demolished by means of dynamite. A small slab of 12 feet span length and 6 feet width was tested during October.

Plans are in progress for additional measurements on the expansion and contraction of concrete due to various causes, including freezing and moisture.

Tests on the coefficient of friction of concrete on various subsoils are likewise in progress. Preliminary tests on clay and sand bases indicate the coefficient of friction to be between 0.8 and 1.0.

Soil-Pressure Investigations.

The soil-pressure building is ready for the installation of soil-pressure disks. Many of these have been completed and are being calibrated.

NATIONAL PARK AND FOREST ROADS.
T. Warren Allen, Chief.

Projects:

National Forest Roads.

District No. 3 - O. N. Powell in charge.

Construction work on the Glorieta-Panchuela Road on the Santa Fe Forest, New Mexico, has been continued during this month. Lack of teams retarded the work but a sufficient crew is at work at the present time.

Three miles of the Salt River-Pleasant Valley Road on the Tonto Forest, Arizona, have been completed. These three miles include some of the heaviest work. The total yardage is about 17,000.

About a mile and a half of the Winslow-Long Valley Road on the Coconino Forest, Arizona, has been completed. This work is going slowly as the present section is the most difficult. With the completion of the second mile the project will be about 40 per cent complete.

A reconnaissance was made of the Clifton-Springerville Road on the Apache Forest, Arizona, as Greenlee County has made application for constructing this road under the new Federal Aid Act. This road will involve some very heavy construction on the lower end outside of the Forest and it is expected that the road will open up the entire southern portion of the Apache Forest which is now inaccessible to vehicles. The estimated cost of the road from Morenci to the northern boundary of Greenlee County is $375,000.

District No. 4 - C. H. Kendall in charge.

Severe storms and an unusual amount of rain, with snow in the higher altitudes, compelled the suspension of construction work in nearly all projects from October 1 to 13.

In Idaho, an organization has been started upon the Payette River Road from Deadwood to Lowman in the Boise Forest.

In Wyoming, upon the Teton Pass Road, work has been slow and interrupted between stations 29 and 93 from the Summit West. Considerable construction maintenance has been necessary since the storm.

In Utah, upon the Kamas-Stockmore Road, camp has been moved to Bear Hill on Wolf Creek and a half mile is being graded. Citizens of Stockmore have donated 11 tons of hay, 2 tons of oats, and 200 bushels of potatoes to encourage the continuance of the work in Duchesne County as long as the season permits.

A crew has been grading a newly located section of the road in Daniels Canyon, Uinta N. F. which will be completed early in November at an expense of about $800.

Upon the Helper-Duchesne road, the work has been confined to clearing two miles, preparatory to grading.

In the Manti Forest, the road is practically completed to the U. S. Experiment Station in San Pete County. Work in Emery County has been suspended for the season.

Mr. Peterson and party have completed the location in Daniels Canyon and are cross-sectioning the extension of the Kamas-Stockmore road.

Mr. Calvert and assistant are working in the Ogden office upon tracings and quantities of the Helper-Duchesne Survey and the Strawberry Valley Survey.

Mr. Brown is with the Construction work upon the Teton Pass Road, restaking the survey of 1914.

A reconnaissance of the Section 8 Project around Mt. Timpanoges from Provo Canyon to American Fork Canyon has been made -- a distance of fifteen miles in Utah County.

An examination of the Logan-Garden City Road (40 miles) has been made and an estimate prepared for Cache and Rich Cos. as a Section 8 project for the Cache N. F.

An examination of the Cedar Canyon-Long Valley route across the Sevier N. F. is being made. One half of this route has been surveyed and application made for Federal Aid under Section 8.

Good Roads meetings under the auspices of the Commercial Clubs of Provo and American Fork have been well attended, the rules and regulations of the Federal Aid Road Act discussed and the proposal of a bond issue advocated.

District No. 5 - C. C. Morris in charge.

Trinity River Road - This project closed down for the season about October 25 owing to the exhaustion of the appropriation. The road is complete to Mile 8½, but 4½ miles have yet to be built to complete the project to Burnt Ranch, the point originally contemplated as the terminus. It is hoped that work may be resumed early next spring.

On the Trinity during the last two or three months, about 110 men have been worked with about the following organization:

1	Superintendent	$150.00 per month
1	General Foreman	3.50 per day
1	Clerk (Forest Ranger)	1100.00 per annum
1	Timekeeper	2.50 per day
1	Instrumentman	2.50 " "
1	Rodman	2.00 " "
1	Blacksmith	2.50 " "
1	Helper	2.00 " "
1	Cook	3.00 " "
1	Second Cook	2.50 " "
1	Dishwasher	2.00 " "
2	Waiters (female)	1.50 " "
1	Choreboy	1.50 " "
1	Clearing Foreman	2.50 " "
6	Laborers	2.00 " "
1	Team	1.50 " "
1	Team Foreman	2.50 " "
8	Teams	1.50 " "
8	Teamsters	2.00 " "
8	Laborers	2.00 " "
1	Rock Foreman	2.50 " "
1	Compressor Operator	2.25 " "
2	Drill Operators	2.00 " "
1	Powder Man	2.00 " "
3	Laborers	2.00 " "
3	Mucker Foremen	2.50 " "
53	Laborers	2.00 " "
1	Culvert Foreman	2.50 " "
3	Laborers	2.00 " "
1	Team (part time)	
4	Finishers	2.00 " "

All employees are furnished subsistence and all teams are fed and shod. On the Trinity Road a horse power stump puller has been used, but on the Salmon a thorough test was made with a drum type hand power machine. This has proven much more economical than the horse machine and is fully as powerful. Either machine will pull oak and fir stumps up to about 30 inches diameter without previous loosening by shooting. The team is useful, even with the hand puller, for moving stumps and logs off the right-of-way.

Summer clearing is not proving very satisfactory, owing to the impossibility of burning and the consequent necessity of dragging all brush and debris out of the way by main strength.

In steep side hill work in earth the first step is to make sufficient cut by hand to permit the passage of a team. Two or three passes then are made with a grading plow, after which the wing plow is taken through four or five times. The grade now is sufficiently wide for the "Little Western" Grader. This moves material loosened by a grading plow. When the grade is so wide that two passes of the grader will not move dirt over the edge, slip scrapers are put on and the material disposed of by side dumping these.

On flat slopes the roots and stones are first displaced by a rocter plow, then such material as is necessary for fills is drifted endways, after which all grading and finishing is performed with the grading plow and grader.

The rock foreman handles drilling and shooting only, all work preceding drilling and the mucking being handled by the mucker foremen. The machine drills are used wherever it is possible to get an air line to the job. The economy of the machine outfit is very manifest. The compressor starts on gasoline then switches to distillate. It has no trouble with a fuel consumption of 2 gallons per hour in supplying sufficient air for two hammers which will put down holes faster than a dozen 3-man drill crews. The location of the mucker foremen and the number of laborers in each gang depends on the material being handled, and varies daily.

Culverts are of log and of rock. The rock culverts usually are put in ahead of the grading and by men from the mucker gang. Log culverts are put in after the grading is nearly complete, in order that teams may be used to handle the logs. The culvert gang is used also on bridge work. Finishing is done by hand on rock sections and with the grader and drag in earth.

ESTIMATE OF MESS EQUIPMENT NECESSARY IN SUBSISTING 10, 30, 60 OR 100 MEN. COMPILED FROM THE RECORDS OF TRINITY RIVER ROAD CAMP, TRINITY NATIONAL FOREST.

	No. Men		10	30	60	100
Article	Description	Size	No.	No.	No.	No.
Axe, hand			1	1	1	1
Basins, wash			2	6	12	24
Board, wash			1	1	1	1
Bowls, mush	Enamel	¾ qt.	12	36	84	132
Bowls, sugar	"		4	8	10	14
Bowls, mixing	"	6 qt.	2	3	6	10
Bowls, mixing	"	3 qt.	4	4		
Bowls, mixing	"	14 qt.		1	2	3
Bowls, mustard			4	8	10	14
Boiler, rice	"	4 qt.	1	1	1	1
Brushes, pot			2	4	4	6
Cleaver		9 in.	1	1	1	1
Cleaver		6 in.	1	1	1	1
Clock			1	1	1	1
Collander	Large		1	1	1	1
Cups	Enamel		12	36	72	120
Dipper	Tin		2	2	4	4
Egg beater			1	1	1	1
Forks, table			12	36	72	120
Forks, meat			2	2	4	4
Grater			1	1	1	1
Griddle	Aluminum	9x19 in.	1			
Grinder, meat			1	1	1	1

Article	No. Men Description	Size	10 No.	30 No.	60 No.	100 No.
Kettles		6 qt.	4	4	4	
Kettles		8 "	6	6	6	6
Kettles		10 "		2	4	4
Kettles		5 gal.		1	2	2
Kettles		10 "			2	3
Knives, table			12	36	72	120
Knives, butcher			2	3	3	3
Knives, paring			2	2	3	4
Knives, bread			2	2	2	2
Ladles, soup			6	6	12	18
Lamps			2	2	2	2
Masher, potato			1	1	2	2
Mill, coffee			1	1	1	1
Opener, can			2	2	3	3
Pot, stock		12 qt.	1	1		
Pot, stock		10 gal.			1	1
Pot, coffee		3 qt.	2	4	8	12
Pot, tea		3 "	2	2	4	6
Boiler, coffee		5 gal.	1	1		
Boiler, coffee		10 "			1	1
Pitcher, syrup		1 qt.	4	8	10	14
Pitcher, milk		1 qt.	4	8	10	14
Pitcher, water		2 qt.	2	4	8	12
Pin, rolling			1	1	2	2
Pans, drip			3	5	10	12
Pans, pudding	Round	2 qt.	6	10	18	24
Pans, pudding	"	3 qt.	6	10	18	24
Pans, pudding	Oblong	2 qt.	6	10	18	24
Pans, pudding	"	3 qt.	6	10	18	24
Pans, pudding	Round	$4\frac{1}{2}$ qt.	2	4	8	12
Pans, dish	Tin	30 qt.		1	2	3
Pans, dish	Agate	20 qt.	2	3	4	6
Pans, fry			3	5	5	5
Pans, milk	Agate	6 qt.	3	3	4	6
Pans, milk	"	4 qt.	3	6	8	12
Platters, meat		14 in.	4	8	12	14
Plates	Enamel	10 in.	20	40	80	150
Plates	"	8 in.	6	6	12	18
Plates, pie	Tin		6	12	24	36
Steamer, potato	Small		1			
Steamer, potato	Large			1	1	1
Shaker, salt			4	8	12	14
Shaker, pepper			4	8	12	14
Steel, butcher			1	1	2	2
Spring balance		50 lb.	1	1	1	1
Steelyard		250 lb.	1	1	1	1
Saucers	Enamel		12	48	84	132
Sifter, flour			1	1	2	2
Spoons, tea			24	48	84	132
Spoons, table			12	36	72	120
Spoons, stirring			2	2	4	6

Article	No. Men Description	Size	10 No.	30 No.	60 No.	100 No.
Saw, meat			1	1	1	1
Turner, cake			1	1	1	1
Tray, waiter			1	1	2	2
Tubs, wash	Galvanized		2	2	4	4
Buckets	"		2	2	4	4
Stoves						
Lunch cans		1 man	2	2	4	6
Lunch cans		4 men	2	4	4	6
Lunch cans		10 men		1	2	4

Construction Equipment
Trinity River Road, 120 Men.

Axes, double bitted	24	Hammer, ball pein	1
Axes, broad	2	" 8#	20
Auger, $1\frac{1}{2}$"	2	" 2# B.S.	2
Anvil, 150#	1	" Nail	6
" 110#	1	Hooks, brush	4
Bags, water, $2\frac{1}{2}$ gal.	60	Knife, Farrier's	1
" stake, canvas	3	Lamps, hanging	6
Barrels, wood, 42 gal.	3	Lanterns, large	12
Bars (60 ft. 1" octagonal steel)		Levels, Abney	2
Belt, lineman's safety	1	Levels, spirit	1
" " tool	1	Line, chalk	300'
Bits, Jennings, set	1	Mattocks	33
Block, snatch, iron $\frac{1}{2}$"	4	Machine, blasting, 30	
Block, swage, 12"x12"	1	shot	1
Board, drawing, 30" x 42"	1	Nippers, Farrier's	1
Brace, ratchet	2	Oiler, 1 pint	3
Buckets, galvanized, 3 gal.	14	Picks, R.R., 5# to 6#	92
Cable, steel, $\frac{1}{2}$", feet	300	" Drift	19
Clamps, cable, $\frac{1}{2}$", Crosby	6	Plows, grading 250#	2
Canteens	24	" rooter, 250#	1
Chain, 3/8", feet	125	" wing, 300#	1
Clevises, plow, small	12	Plumb bob	3
Climbers, lineman's	1	Poles, range	2
Connectors	1	Pipe stock & dies, set	1
Cutter, B.S., hot	2	Pliers, 7"	2
Cutter, B.S., cold	2	Peavies	8
Drills, twist, 1/8" to 1"	9	Pipe, 1", feet	800
" post, Champion	1	" $1\frac{1}{2}$", feet	800
Drawknife, 14"	1	" $\frac{3}{4}$", feet	300
Funnels, large	2	Padlock, Forest Service	4
Forge, toolmakers, Champion, #402	1	Rakes, garden, heavy	2
" blacksmith, Champion, #409	1	Rope, Manila, $\frac{1}{2}$"	
Fuller, top	1	diameter	500'

Fuller, bottom	1	Rope, Manila 1" diameter	300'
Flatter	1	Rod, fence	1
Forks, manure	2	Squares, steel	2
Faucets, ¾"	3	Saw, hack	1
Grinders, emery	2	" hand - 1 rip, 2	
Grindstone, 2" x 18"	1	crosscut	3
Hardy, B.S.	1	" falling, 7 ft.	3
Hoof trimmers, Farrier's	1	" tool	1
Hammer, Farrier's	1	Straight edge, 36"	1
Spoon, drill	1	Stump puller, Kirstin	
Screw plates, set	1	King (with cables)	1
Swage, top	6	Shovels, long handle R.P.	131
" bottom	1	Stove, heating	1
Sacks, mail	2	Tongs, B. S.	2
Singletrees	32	Transit, engineer	1
Steel, tool, 1" square, feet	16	Vise, B. S., bench	1
" drill, 1" octagonal, feet	300	Wheelbarrows, steel pan	
Steelyards, 250#	1	tubular frame	36
Stretcher chains	12	Wrenches, Crescent, 10"	
" lineman's	1	& 12"	2
Scrapers, drag, #2	12	Wrenches, Monkey, 12"	2
Shares, plow, extras	3	" Stillson, 2-14"	
Service cocks, ¾"	2	1 - 18"	3
Screwdrivers, 8" and 12"	2	Wedges, falling	6
Tubs, galvanized, wash	6	" splitting	6
Typewriters, Underwood	1	Wire, lead, blasting, ft.	500'
Table, Century Adjustable	1	Air compressor, gas driven	
Tapes, metallic, 50 ft.	2	Duples 8"x6", Ingersoll-	
" steel, 100 ft.	2	Rand, with drills, hose	
Tape repair outfit	1	and blacksmith tools	1
Telephone, wall	1	Drags, steel, road	2
		Grader, Little Western	1

Tent Quarters.

No.	Tents on Hand	Purpose	Flies on hand
1	14 x 24	Kitchen	26 x 26
1	18 x 36	Mess	26 x 36
1	16 x 20	Mess	26 x 20
1	26 x 40	Stable	32 x 40
1	14 x 16	Office	24 x 18
2	12 x 14	Bosses	14 x 20 (2)
1	12 x 14	Cooks	14 x 20
1	16 x 35	16 men	26 x 36
1	16 x 24	10 men	26 x 26
1	12 x 16	4 men	16 x 20
3	12 x 14	12 men	14 x 20 (3)
1	10 x 12	2 men	12 x 14
1	9 x 9	1 man	12 x 14
5	16 x 24	50 men	26 x 26 (5)

The above list is somewhat miscellaneous and a number of the sizes should be eliminated if buying all new tents.

CONSTRUCTION SUPPLIES AND MATERIALS, TRINITY RIVER ROAD.

Article
Batteries, electric
Caps. giant
Coal, blacksmith
Compound, welding
Distillate, engine
Dressing, belt
Exploders, electric
Fuse
Files, rat tail
Files, mill
Files, taper
Files, bastard
Grease, cup
Grease, axle
Gasoline
Graphite
Hinges, door
Hasps
Iron, norway
Lumber, 2" x 4" & 1" x 12"

Article
Lime, chloride
Lacing, belt
Latches, door
Nails, assorted
Nails, horseshoe
Oilcloth
Oil, cylinder
Oil, engine
Oil, kerosene
Padlocks
Powder, black
Powder, dynamite
Plugs, spark
Screen, wire
Shoes, horse
Steel, plow
Steel, pick
Steel, drill
Tape, friction
Waste
Wire, connecting

OFFICE EQUIPMENT AND SUPPLIES, TRINITY RIVER ROAD.

Article
Clips, paper
Erasers, ink
Erasers, pencil
Envelopes, white
Envelopes, manilla
Fastener, paper
Files, letter
Files, bill
Files, property card
Guides, index
Holders, pen
Paper, letter
Paper, letter (seconds)
Paper, typewriter
Paper, cross-section
Paper, carbon (typewriter)
Paper, carbon (pencil)
Pencils, drawing
Pencils, copying
Pen, points
Ribbons, typewriter

Article	
Typewriter	
Ink	
Forms	**No.**
Book, time	875
Book, memo.	289
Informal proposal supplies	R
Vouchers, service other than personal	5-A
Weekly report	125
Requisitions	668
Purchase orders	942-S
Vouchers, reimbursement	4
Vouchers, personal services	3
Pay roll, personal services	2
Memo. Invoice purchases	939-C
Cards, distribution	24
Cards, property	331
Cards, transfer	874-16
Sub-vouchers	4-A
Book, engineer's cross-section	
Book, engineer's Loose leaf and filler	
Tire report card	874-15

Salmon River Road - Construction work for the season closed on October 10, with 4 miles completed. The location survey reached Mile 20, leaving seven miles yet to be surveyed. The notes from this survey are sent into the San Francisco Office and both plotting and design completed there.

The Highway Engineer represented the District Forester at three conferences with the California Highway Commission in the matter of the Federal aid road program.

The Laguna Project on the Cleveland National Forest was visited during the month for the purpose of right-of-way negotiations with objecting land owners.

State Work - Oregon. J. H. Ball in charge.

Medford-Crater Lake Highway Survey.

During October five assistant draftmen have been helping with the work on the Medford-Crater Lake Highway plans.

It was hoped to have the design and plans completed for the first thirty-five miles of this location by the end of the month.

ROAD ECONOMICS.
J. E. Pennybacker, Chief.

A. R. Losh, of Manhattan, Kansas and A. L. Luedke, of Milwaukee, Wisconsin, have been appointed Engineer-Economists. Mr. Luedke reported for duty on October 1 and Mr. Losh October 16.

Statistical Investigations

The bulletins on Road Mileage and Revenues for the Central, Western, Mountain and Pacific States and the summary for all of the States are now in the hands of the printer and should be ready for distribution in the very near future.

The bulletin on the Economic Survey of County Highway Improvement was issued as Bulletin No. 393 on October 23.

State Highway Management Studies

The State Highway Management Studies are progressing well. These studies are being conducted by J. D. Fauntleroy, L. I. Hewes, H. S. Fairbank, J. J. Tobin, A. R. Losh, A. L. Luedke and Miss A.F. Johnston. They have been completed for the following states: Alabama, California, Colorado, Connecticut, Idaho, Illinois, Iowa, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, Montana, New York, New Mexico, Nebraska, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Dakota, Tennessee, Utah, Virginia, Washington, West Virginia, and Wisconsin.

E. O. Hathaway has made the necessary investigations to complete the studies of the following States: Pennsylvania, Maine, New Hampshire, and Vermont. He has not yet returned from his trip to the New England States. It is expected that all of the information needed to complete this study will be in the Office by November 15, or will have been requested from the various State Highway Departments on or before that date. The preparation of the various graphic charts, organization charts, procedure charts, etc., probably will take longer.

Lectures and Road Models.

M. O. Eldridge attended the International Dry Farm Congress at El Paso, Texas from October 14-24. He had an exhibit of road models and delivered an address before the Congress.

J. J. Tobin is at Jamestown, New York in charge of an exhibit of road models and to preside over a conference of road supervisors from October 30 to November 4.

L. I. Hewes addressed the Annual Congress of the American Prison Association on October 12 at Buffalo, New York.

An exhibit of road models was on display under the auspices of the Western Pennsylvania Exposition Society at Pittsburgh, August 30 to October 14. These models are now on their way to the Office and will be available for use at other places.

Economic Post Road Studies.

During the month W. E. Rosengarten made the final economic study of the Maine Post Road and is back in the Office continuing the work and writing the reports on these studies.

County Management Studies.

R. F. Eastham is engaged in writing up a number of county management studies made before he was detailed to take charge of the experimental camp at Atlanta, Georgia.

Convict Studies.

During the month of September H. S. Fairbank was assigned at the request of Lamar Cobb, State Engineer of Arizona, to make an inspection of the convict camps in Arizona. He has prepared a report making recommendations for the improvement and methods of management and discipline, camp sanitation, and promoting the efficiency of all the convict camps of the State. This work was completed October 3.

Advice and Cost Accounting.

A study of highway conditions existing in the town of Westerly, Rhode Island and the method of highway administration now practiced in that town was made by J. J. Tobin, and a report prepared suggesting a system of cost accounting and recommending certain desirable changes in the system of road administration.

Legislation.

Requests have been received from interested individuals, associations, and state officials for tentative drafts of bills creating State Highway Departments in the States of Indiana, Nebraska, Nevada, North Dakota, South Carolina, South Dakota, Texas, and Wyoming.

The Oregon Association of County Judges and Commissioners, at their annual convention held in Salem, Oregon, September 29, passed a resolution requesting this Office to suggest a tentative codification and revision of all road laws of the State. This resolution has the endorsement of the Attorney General of the State, The Oregon Society of Engineers, the Portland Association members of the American Society of Civil Engineers, and the Portland Chamber of Commerce. This work is done by L. E. Boykin, and tentative drafts of highway bills have been prepared for the States of North Dakota, Texas, and Wyoming.

RURAL ENGINEERING.
E. B. McCormick, Chief.

Domestic Water Supply and Sewage Disposal.

Surveys are being made at Rome, Ga., by B. F. Heidel, S. H. E., for plans for waterworks at the Berry School.

A design of a septic tank installation for the Granville Test Farm, Oxford, N. C. has been made and transmitted.

Farm Structures.

Drawings for the combined sheep barn and laboratory to be built of reinforced concrete at the Beltsville Experiment Farm, Md., are still in course of preparation.

The erection of pens for experimental hog feeding has been started at Beltsville Experiment Farm. It is expected that work will be completed by November 10.

Final drawings are being prepared for several hog houses. The designs are the result of investigations made by W. Ashby, Barn Arch., on Reclamation Projects.

Drawings for a small general barn to house five horses and four cows have been completed and are ready for distribution.

Field Experiments.

Tests on the effect of width of tires on dirt roads are in progress at the Arlington Experimental Farm, Va. Seven tests have been completed to date. The data from these tests is being tabulated.

Rural Engineering Problems Involving Mechanical Principles.

In addition to the correspondence along the lines indicated in the last Field Letter, a memorandum on ice house construction, illustrated with drawings, has been prepared for use in connection with answering the numerous inquiries received from all parts of the country.

A. D. Morehouse is on an extended tour through the Middle West and South for the purpose of bringing the Division in closer touch with farm operations generally.

IRRIGATION INVESTIGATIONS.
Samuel Fortier, Chief.

Administration.

In addition to the states named in the field letter for September, Dr. Fortier visited Nevada, Idaho, Oregon and California. Cooperation in irrigation is being carried on in Nevada under two main lines. One of these pertains to a more economical use of the surface waters of streams and the other to the development of underground waters by means of pumping plants. The joint funds for both lines of work for the current year is made up of $4000 from this Office and about $5000 from the state of Nevada and its institutions.

Perhaps no state of the Union is in greater need of federal aid. With a total population of less than one-third that of the District of Columbia it is under the obligation to maintain all the machinery of a state government and all the institutions that pertain to a state. Relief from the excessive burden of taxation required to provide so much revenue can come only from a larger population and a fuller development of the latent resources of the state. Its greatest asset consists of its large extent of fertile, arable land. Nevada is as large as the Kingdom of Italy which supports a population of 35,000,000 people but its fertile soil is of little value unless it is irrigated, and the water supply of the state is very limited. There can, therefore, be no question of the value of the cooperative work now being carried on under the supervision of F. L. Bixby, I. E.

The irrigation work in California is increasing in scope and popularity. In southern California C. E. Tait, I. E., has about

completed a study of the institutional side of irrigation in which he has discussed at length the customary forms of organization. Mr. Tait, assisted by F. J. Veihmeyer, A. I. E., is likewise engaged in completing a report on the application of water to crops in Imperial Valley. The experiments which have been in progress for some time at Riverside under W. W. McLaughlin, I. E., are attracting attention. These have for their main object a study of capillarity and the relation of this force to the distribution of irrigation water in soils. The recently inaugurated work in sewage irrigation in charge of N. B. Williams, I. E., is likewise attracting attention in Southern California where both the climate and the physical conditions are so favorable for this method of sewage disposal.

In the northern part of the state both the office of the state engineer and the University of California continue their influential support of cooperative irrigation. The results of the work done and of reports published seem to be bearing fruit. This is particularly true of the report on irrigation resources of California and the more recent reports on irrigation districts by Frank Adams, I. M. The work done by Ralph D. Robertson, I. E. on the irrigation of rice has been pushed vigorously and already has effected a large saving to the rice growers of the Sacramento Valley. A report on irrigation practice in growing small fruits in California by Wells A. Hutchins, A. I. E., has been printed as Circular No. 154 of the University of California Agricultural Experiment Station. Those who desire copies should apply to the Berkeley Office.

A manuscript entitled "Investigations of the Economic Duty of Water for Alfalfa in Sacramento Valley, California, 1910-1915" by Frank Adams, R. D. Robertson, S. H. Beckett, W. A. Hutchins, and O. W. Israelsen, has been submitted to the Washington Office for publication. As the title implies, this manuscript covers extensive studies of the duty of water for alfalfa in Sacramento Valley which the Berkeley Office has been conducting since 1910, the work being done at the University of California Farm at Davis and on 54 alfalfa farms in Sacramento Valley. The work at Davis indicated that under conditions present on the University Farm, namely, a rainfall of about 17 inches and a medium loam soil, at least 10 or 12 feet deep, a depth of 30 to 36 inches of water per annum represents the most economical duty for alfalfa. The supplemental investigations on the 54 farms indicated that the duty found at Davis holds for the entire valley with the exception of the very open soils and very heavy or impervious soils. In the case of very open soils it was found difficult to apply water in such a way as to get along with 30 to 36 inches in depth per year and in the case of the very heavy soils it was found impossible to get as much water as this into them in their present poor physical condition. It was found, however, that the use of more than 30 to 36 inches per year on the open soils and of less than this on the heavy soils did not increase yields.

R. P. Teele, I. E., spent a part of the month in inspecting the field work in Arizona and New Mexico and attending the International Irrigation Congress which met at El Paso, October 14 to 18. The attendance at the Irrigation Congress was only fair. At the opening session former Assistant Secretary Jones of the Department of the Interior who represented the President of the United States for this occasion, spoke at length of the needs and future of the United States Reclamation projects, laying special emphasis on the need of work by various divisions of this Department in developing successful agriculture on these projects. For most of the papers the Congress met in sections. The section dealing with irrigation practice and irrigation and drainage engineering were most largely attended and presented the best programs. In the former section Mr. J. S. Welch, who represented the State of Idaho, presented a paper on the relation of size of stream and frequency of irrigation to crop yields, based on work carried on in cooperation with this Office at Gooding, Idaho; and Director Harris of the Utah Agricultural Experiment Station presented a paper on the time of irrigating wheat, based on experiments at the Utah Station in which this Office has cooperated. In the engineering section Mr. Teele made a statement of the irrigation work of this Office. W. L. Rockwell, I. M. in charge of the irrigation work of this Office in Texas, also attended the Congress.

After the Irrigation Congress Mr. Teele visited the New Mexico Agricultural College, where the Office is cooperating in irrigation work. The work at that station, carried on by D. W. Bloodgood, Agent, consists in the completion of pump tests begun by F. L. Bixby, I. E. the continuation of duty of water experiments, and observations of ground water levels throughout the Mesilla Valley. The ground water is rising to an alarming extent in this valley and an effort is being made to determine the source of this water, as the first step in checking the injury.

P. E. Fuller, I. E. visited El Paso October 18 and 19 for conference with Mr. Rockwell on methods used in duty of water studies and with Mr. Teele on reports of field work in Arizona.

Use of Water.

Frank Adams, R. D. Robertson, and W. A. Hutchins, of the Berkeley Office, each delivered lectures at the annual short course at the University Farm at Davis. W. W. Weir, of Berkeley, also delivered lectures in the same course.

Milo B. Williams, I. E., left Berkeley on October 16 for Ogden, Utah, to make a survey of sewage irrigation at that place. Earlier in the month he made a survey of a sewage irrigation tract at Santa Rosa, California.

Frank Adams, I. M. delivered a lecture before the Moreland Local Farmers' Union, Santa Clara Valley, near San Jose, California,

on orchard irrigation on October 11 and again in San Jose before the Santa Clara County Farmers' Union on October 28 on the same subject.

S. H. Beckett, I. E., has completed a manuscript covering cooperative irrigation experiments at the University of California Farm at Davis, 1910-1915. This manuscript deals with all of the irrigation experiments at Davis during this period except those relating to the measurement of water and the duty of water for alfalfa.

Pumping for Irrigation.

P. E. Fuller, I. E., has submitted a paper on Pumping for Irrigation on the Farm, which is to be published in the next Yearbook of the Department.

Flow of Water.

F. C. Scobey, I. E., and P. A. Ewing, A. I. E., returned to Washington early in the month after the completion of the season's investigations on the flow of water in concrete pipes. During the summer nearly 100 observations were made on pipes in Canada and the United States, and a range of diameters from 6 to 120 inches was secured. Mr. Scobey is now engaged in the preparation of a bulletin based on the 1915 and 1916 experiments.

Drainage of Irrigated Land.

The past season has been marked by widespread activity in the organization of drainage districts and the construction of drainage works. There was too much of this work for Messrs. R. A. Hart, W. W. Weir, and W. G. Sloan, who were transferred last spring from the drainage to the irrigation division to carry it on. In consequence, Messrs. V. M. Cone, L. M. Winsor, F. L. Bixby and M. R. Lewis also have been delegated to perform drainage as well as irrigation work when necessity arises.

In Idaho Mr. Sloan has done work on the following districts during the past season: The Twin Falls Drainage Tract, the Boise Valley Drainage District, and the Canyon County Drainage District No. 1. He likewise has made either a preliminary survey or a reconnaissance on proposed districts at Gannett and Roberts, Idaho, and at Ontario and Nyssa, Oregon. In California Mr. Weir has had to apply his energies to three phases of agricultural engineering, namely, drainage, flood control and terracing. The drainage investigations have been carried on chiefly at Oxnard, Chino, Santa Ana and Santa Maria. The flood control work has been in San Diego County where so much damage was done by the floods of last winter, and the terracing has been confined to Ventura county. Mr. Hart, in his drainage work in Utah, Wyoming, New Mexico, and Arizona has covered a still wider field and has managed to supervise the construction of several projects by going from one to the other at frequent intervals.

R. A. Hart, S. D. E., reports the following record of three trenching machines operating in the drainage development on South tract of the Delta project, Utah; Two Buckeye's are in use, cutting a trench 18 inches by 6½ feet, and a P & H cutting a trench 21 inches by 6½ feet.

Machine	Running time	Repairs	Cleaning	Length of Trench	Av. Depth	per Hour
Buck. No. 1	1212 hr.	713 hr.	17 hr.	136,854 ft.	5.3 ft.	113 ft.
Buck. No. 2	642 hr.	406 hr.	3 hr.	59,993 ft.	5.3 ft.	93 ft.
P. & H.	1233 hr.	500 hr.	133 hr.	123,938 ft.	5.0 ft.	100 ft.

Maximum monthly run was by P. & H. in July, 42,414 feet in 405 hours or 105 feet per hour being recorded. The P. & H. machine was used for the larger tile, burning gasoline. The Buckeye used distillate and made about the same record in feet per gallon.

W. W. Weir, S. D. E., began a drainage survey for the lands below Reno, Nevada.

DRAINAGE INVESTIGATIONS.
S. H. McCrory, Chief.

Administration.

With the close of October, Chas. W. Okey, S. D. E., who has been connected with the Office for a number of years, leaves the staff to assume charge of the construction work of the Combahee Corporation project at Whitehall, South Carolina. Lewis A. Jones, S. D. E., will direct the work in south Louisiana and in Florida from the Montgomery Office. Mr. Jones returned to Montgomery October 14, and after attending to some accumulated work at that office went to New Orleans where he conferred with Messrs. Okey, Gregory and Kirschner concerning the Louisiana work. On October 24 Mr. Jones and Mr. Okey went to Jacksonville and other places in Florida to inspect work in that field.

D. G. Miller, S. D. E., who was formerly in charge of the drainage work in the Denver office, spent a portion of the month at Denver arranging to close up work in Colorado and shipping office equipment to Chicago where an office will be opened in the Federal Building at south Chicago.

Edwin W. Grimmer of Missouri has been appointed to the position of Junior Drainage Engineer, and is expected to report for duty Nov. 7 at Jackson, Tenn., where he will make investigations relating to run-off, continuing the work prosecuted by H. S. Andrews last winter.

Farm Drainage.

J. R. Haswell, S. D. E., and W. N. Hall, D. E., examined various tracts in Maryland, Delaware, and New Jersey; Mr. Hall also made a number of examinations in Virginia.

G. H. Hart, J. D. E., after completing his work in Michigan with Mr. Boyd left for Montgomery, Alabama, arriving October 13, where he will assist Lewis A. Jones, S. D. E., with the work in that state.

Dan S. Helmick, J. D. E., continued work in the Washington Office during the month and also assisted Mr. Yarnell, S. D. E., on the Arlington Farm experiments. He assisted J. R. Haswell, S. D. E., in staking out a number of drains on the Animal Husbandry Farm at Beltsville, Maryland.

Fred F. Shafer, D. E., after completing various reports on tile projects, left Washington on October 22 for various places in West Virginia, Virginia and Kentucky.

C. E. Ramser, D. E., has submitted the final draft of his manuscript on Terracing which will be submitted for publication as a Department bulletin.

From October 16-20, H. M. Lynde, S. D. E., attended the North Carolina State Fair at West Raleigh at which he had a drainage exhibit. Later in the month he had a similar exhibit at the Cape Fear Fair, Fayetteville.

Reports Transmitted.

P. W. Tankard Farm, Weirwood, Virginia, by W. N. Hall, D.E.

Reports Received.

Herin & Graham Tracts, Barbour County, Alabama, by R. L. Grable.

Overflowed Lands.

S. W. Frescoln, D. E., after completing the field work of Beaver Dam Drainage District, Clarke, Oglethorpe and Madison Counties, Georgia, returned to Washington October 4, where he worked up the plans and reports. On October 29 he left for Charleston, South Carolina, where he will assist Mr. Eason in his work in that state.

O. G. Baxter, S. D. E., made a survey of the proposed Brown Creek Drainage District, Oklahoma, and reviewed the plans by Messrs. Winter and Dove for the Sequoyah County Drainage District No. 1, Oklahoma. He also inspected the work being done on the Cypress Creek Project, Arkansas.

Geo. R. Boyd, S. D. E., and W. E. Ayres, J. D. E., arrived at the Washington Office October 13, where they will prepare a report and plans on the drainage of lands along the Saginaw River, Michigan.

On October 2, F. G. Eason, S. D. E., addressed a number of Gaffney, S. C. landowners who are contemplating forming a drainage district of lands along Thickety Creek.

P. T. Simmons, S. D. E., on October 16 returned to duty and is continuing investigations in South Dakota.

D. G. Miller on October 12 made an examination of lands in the vicinity of Brady, Nebraska.

Reports Transmitted:

Marcus Drainage District, Stevens Co., Wash., by W. A. Kelly, D. E.
Grand River Valley, Missouri, by S. H. McCrory, Chief.
McRae Drainage District, Telfair County, Georgia, by J. V. Phillips, S. D. E.

Reports Received:

Red Lake Drainage District, Charles Mix County, South Dakota, by P. T. Simmons, S. D. E.
Spring Creek Drainage District, Lincoln County, Nebraska, by C. E. Ramser, D. E.
Beaver Dam Creek, Clarke, Oglethorpe & Madison Counties, Georgia, by S. W. Frescoln, D. E.

Swamp Lands.

S. H. McCrory, Chief, and Lewis A. Jones, S. D. E., made a reconnaissance examination of St. Lucie County, Florida.

F. G. Eason, S. D. E., continued to supervise construction work on the Combahee Corporation Project, South Carolina.

Before leaving Washington, Lewis A. Jones, S. D. E. assisted by Dan S. Helmick, J. D. E., completed a compilation of swamp land areas in the various states.

Reports Transmitted:

Old State Road Swamps, Berkeley County, S. C. by F. G. Eason, S. D. E.
Caw Caw & Scippio Swamps, Brunswick County, N. C. by H. M. Lynde, S. D. E.

Reports Received:

Run-off Investigations in Western Tennessee, by C. E. Ramser, D. E.

Peat, Turf and Muck.

J. R. Haswell, S. D. E., completed field investigations for this season and returned to the Washington Office on October 9.

Construction, Operation, and Maintenance.

The first half of the month D. G. Miller, S. D. E., was engaged in studying maintenance of drainage ditches located in Iowa. As soon as he gets located in the Chicago office he will again resume these studies.

Run-off Investigations.

Chas. E. Ramser, D. E. left Washington on October 29 for Jackson, Tenn., where he will instruct Edwin W. Grimmer, J. D. E. in collecting run-off data on water courses in that vicinity. The following tables, Nos. 3, 4, and 5, show interesting data secured during last years investigations in western Tennessee.

Table No. 3.

Hydraulic Elements and Values of n in Kutter's Formula.

Gage height	Average cross sectional area sq. ft.	Discharge sec.-ft.	Mean velocity ft./sec.	Slope	Mean hydraulic radius	c.	n.	Remarks.
Cypress Creek at Bethel, Tenn. Gage height at bank-full stage = 7.0								Banks very ragged & irregular, cross-section not uniform; Channel filling up with sand and in poor condition.
Low stage:	5.57	3.18	0.57	.00128	0.44	24.1	.040	
South Fork of the Forked Deer River at Finger, Tenn. Gage height at bank-full stage = 8.0								Banks fairly regular covered with grass, weeds and small bushes, sandy soil; channel not in very good condition.
3.52	32.7	50.7	1.55	.000855	1.57	42.3	.0350	
3.55	34.0	54.1	1.59	.000923	1.59	41.6	.0360	
3.75	36.6	65.7	1.79	.000824	1.71	47.8	.0320	
4.7	51.0	97.4	1.91	.000875	2.16	43.9	.0372	
5.75	74.2	166.1	2.24	.000564	2.73	57.1	.0304	
8.0	140.4	371.8	2.65	.000620	3.64	55.8	.0335	
North Fork of the Forked Deer River at Trenton, Tenn. Gage height at bank-full stage = 10.3								Banks very smooth, regular, and steep. Channel clear and in good condition.
2.30	49.2	37.6	0.76	.000106	1.93	53.4	.0291	
2.50	55.0	59.4	1.08	.000126	2.08	66.6	.0243	
4.95	137.4	272.1	3.14	.000170	3.44	88.4	.0207	
9.40	316.0	1167.0	3.70	.000382	6.22	75.6	.0271	

Table No. 4.

Hydraulic Elements and Values of n in Kutter's Formula.

Gage height	Average cross sectional area sq. ft.	Discharge sec-ft.	Mean velocity ft/sec	Slope	Mean hydraulic radius	c	n	Remarks.
South Fork of the Forked Deer River at Campbell's levee near Jackson, Tenn.								
Old straight channel, bank-full stage = 9.0								Banks irregular, caving, covered with vegetation; roots of trees on bank; bushes in bottom of channel and deep holes in bottom. Straight course, fairly uniform.
2.5	196.2	395.2	2.01	.000584	4.44	39.5	.0500	
3.52	240.2	545.9	2.27	.000724	5.09	37.2	.0550	
3.74	250.0	557.0	2.23	.000750	5.23	35.6	.0582	
4.30	275.0	735.7	2.68	.001088	5.56	34.4	.0615	
4.45	281.9	715.1	2.54	.000952	5.66	34.6	.0619	
4.95	305.0	797.8	2.62	.001022	5.96	33.1	.0652	
7.0	403.2	1066.6	2.64	.000501	7.19	44.1	.0505	
Old curved channel, bank-full stage = 9.0								Banks and crosssection very irregular, trees lying across channel; much drift in channel; bottom very irregular; main current changes from side to side of channel; four rather sharp curves in course; banks caving badly; condition of channel typical for old channels in this section of Tenn
2.5	241.2	395.2	1.64	.003773	4.15	13.0	.152	
3.52	311.5	545.9	1.76	.003812	4.99	12.7	.162	
3.74	327.3	557.0	1.70	.003645	5.16	12.4	.169	
4.30	366.0	735.7	2.01	.003450	5.56	14.7	.150	
4.45	376.7	715.1	1.90	.002709	5.68	15.3	.146	
7.0	575.8	1066.6	1.85	.001486	7.60	17.4	.140	
Rough dredged channel, bank-full stage = 9.0								Banks and bottom very irregular, no uniformity in cross-section, surging and rolling motion in water, no obstructions in channel, high values of n due to great irregularities in channel cross section.
2.5	176.1	395.2	2.24	.000571	3.61	49.4	.0374	
3.52	249.0	545.9	2.19	.000552	4.65	43.2	.0455	
3.74	265.0	557.0	2.10	.000633	4.85	37.8	.0530	
4.30	305.0	735.7	2.42	.000452	5.33	49.2	.0410	
4.45	315.6	715.1	2.27	.000300	5.45	56.1	.0363	

Table No. 5.

Hydraulic Elements and Values of n in Kutter's Formula.

Gage height	Average cross sectional area sq. ft.	Discharge sec-ft.	Mean velocity ft/sec	Slope	Mean hydraulic radius	c	n	Remarks.
South Fork of the Forked Deer River at Henderson, Tenn. Gage height at bank-full stage = 9.5								Banks fairly uniform and smooth, no vegetation; course straight channel in good condition.
2.85	73.3	120.8	1.65	.000257	2.46	65.5	.0260	
3.46	89.0	169.4	1.90	.000393	2.81	57.2	.0304	
3.55	91.5	193.2	2.12	.000305	2.87	71.5	.0247	
5.41	147.0	358.0	2.43	.000361	3.96	64.4	.0292	
6.00	168.3	434.6	2.58	.000345	4.34	66.9	.0289	
South Fork of the Forked Deer River at Roberts, Tenn. Gage height at bank-full stage = 10.5								Banks very regular and smooth; uniform cross section; channel free from vegetation or obstruction, channel in very good condition.
5.82	328.4	614.3	1.87	.000094	5.76	80.6	.0255	
7.02	390.0	798.2	2.04	.000094	6.50	83.0	.0254	
7.62	421.8	919.4	2.18	.000096	6.84	84.9	.0252	
8.4	465.0	1252.1	2.70	.000124	7.28	89.7	.0240	
8.9	494.0	1503.6	3.04	.000166	7.55	86.1	.0248	

LIBRARY

The following books have been bought for the Library during the last year.

Roads and Bridges.

Bond, P. S. The engineer in war.
Tucker, James Irwin. The American Road.
Georgia. Chamber of Commerce. Motor-way year book.
Lancaster, Samuel C. The Columbia. America's Great Highway.
Hool, Geo. A. Bridges and culverts.
Lyle, Wm. T. Parks and park engineering.
Watson, Wilbur. General specifications for concrete bridges, 3d ed.
Burnside, Wm. Bridge foundations.
Fish, J. C. L. Engineering economics.
Hess, H. D. Graphics and structural design.
Bruce, Robert. The national road.
Johnson, Bryan & Turneaure. Theory and practice of modern framed structures. Pts. 11 and 111.
Fowler, C. E. A practical treatise on sub-aqueous foundations.
Waddell, J. A. L. Bridge engineering.
Burr, Wm. H. The elasticity and resistance of the materials of engineering. 7th ed.
Harger and Bonney. Handbook for highway engineers. 2d ed. rev. and enl.

Irrigation and Drainage.

Bligh, W. G. Dams and weirs.
Etcheverry, B. A. Irrigation structures.
Williams and Hazen. Hydraulic tables.
Newell, F. H. Irrigation management.
Harper, Joseph. Hydraulic tables.
Hiscox, Gardner D. Hydraulic engineering.
Ohio. Miami Conservancy District. Report ... submitting a plan for the protection of the district from flood damage.
Mead, D. W. Water power engineering.
California. Los Angeles County. Report of Board of Engineers Flood Control.
Jeffery, J. A. Text-book of land drainage.
Gibson, A. H. Hydraulics and its application. 1915 ed.
Daugherty, R. L. Hydraulics.
Bligh, W. G. The practical design of irrigation works.
Barnes, Alfred A. Hydraulic flow reviewed.

Rural Engineering.

Hiscox, G. D. Modern steam engineering.
Rafter and Baker. Sewage disposal in the United States.
Stephenson, J. H. Farm engines and how to run them.
Kidder, F. E. Architects' and builders' pocketbook. 16th ed.
Brookes, L. Elliott. The practical gas and oil engine hand-book.
Anderson, F. I. Electricity for the farm.
Lewis and Chandler. Popular handbook for cement and concrete.
Campbell, H. Colin. Concrete on the farm and in the shop.
Hanson, E. S. Concrete silos.
Bozell, Harold V. Data on municipal plant operation in Oklahoma.
Hiscox and Page. Gas, gasoline and oil-engines.
Hiscox, G. D. Compressed air.
French and Ives. Agricultural drawing for the design of farm structures.
Marks, Lionel L. Mechanical engineers' handbook.
Goldingham, A. H. Diesel stationary and marine engines.
Cain, William. Earth pressure, retaining walls and bins.
Timbie and Higbie. Alternating-current electricity.
Timbie, W. H. Essentials of electricity.
Timbie, W. H. Elements of electricity.
Güldner, H. Internal combustion engines.
American Society of Mechanical Engineers. Power test code.
Lazell, E. W. Hydrated lime.
Bullens, Denison K. Steel and its heat treatment.

Miscellaneous.

Gardner, H. A. Paint technology and tests.
Ostwald, W. Handbook of colloid chemistry.
Warnes, Arthur H. Coal tar distillation.
Ostwald, W. Die Welt des vermachlässigten dimensionen.
Claudel, J. Handbook of mathematics.
Barker, G. F. Physics.
Woolley, Edwin C. The mechanics of writing.
Weld, LeRoy D. Theory of errors and least squares.